CUTEC News

EDITORIAL

TARGETING ADDED VALUE FOR CLAUSTHAL AS A SCIENTIFIC CENTRE

Dear Reader,

At the end of 2014 the Technical University of Clausthal was commissioned by the state of Lower Saxony Ministry of Science and Culture to draw up a Masterplan "for the promotion of existing and development of expected scientific excellence, as well as scientific and social relevance."

The launch of the Masterplan was officially confirmed by Minister Heinen-Kljajić at a press conference in September 2016. This enabled us to begin putting it into practice.

Projects have already been launched for all four research focus areas presented in the Masterplan, largely corresponding exactly to the CUTEC portfolio:

With a view to boosting electromobility, for example, researchers from the Technical University of Clausthal, the Fraunhofer Society and the Lower Saxony Energy Research Centre (EFZN) are working on new-generation batteries. The research is being coordinated at the new Battery and Sensor Test Centre on the Energy Campus of the Technical University of Clausthal in Goslar.

The subjects of raw material securing and resource efficiency are the focus of activities at the Secondary Recycling Centre, which was launched in the Harz region in February with the support of the state government. It is advancing the recycling of industrially key strategic metals in conjunction with industrial partners on a regional (REWIMET), national (GERRI) and European (KIC EIT Raw Materials) basis.

Our scientists are developing new-style materials and processes for applications including the automotive and aircraft manufacturing industries. In this context, since February 2016 the Science Ministry has been funding a doctoral programme in the field of high-performance lightweight construction techniques.

The Cyber-physical Systems and Simulation research focus area is working in the future-oriented field of digitisation. Software experts are collaborating strategically with Volkswagen AG in the IPSSE research alliance, and the Harz Regional IT Network is supporting businesses around the region on the road to Industry 4.0.

It was decided on November 18, 2016 that CUTEC will become the fourth research centre of the Technical University of Clausthal in the Summer of 2017, joining the EFZN, the CZM and the SWZ . The decision was preceded by an evaluation of energy research activities at CUTEC, at the EFZN and at the TU, which revealed highly promising co-operation links in particular in the field of raw materials and recycling between the TU Clausthal and CUTEC.

Based on the new association, a research centre can be directly assigned to each of the four research focus areas within our Masterplan, and a consistent, harmonious research structure can be established.

Our shared aim will be to generate added value for Clausthal as a scientific centre. The first steps in joining CUTEC to the TU have already been made at an operational level.

CUTEC was created out of the Technical University of Clausthal, and we are looking forward to merging with it once again to form a single unit. And in terms of our work within the research focus areas, the timing is perfect.

So welcome to you, dear CUTEC staff. We look forward to working together.

Best regards,
Thomas Hanschke
President of the Technical University of Clausthal

CUTEC is a Company of the State of Lower Saxony

HOW VALUABLE HIGH-TECH RESOURCES CAN BE OBTAINED

Leading raw materials scientists present their research work at the BMBF Status Conference

The sponsorship programme "r⁴ – Industrially key strategic raw materials" run by the German Federal Ministry of Education and Research (BMBF) is assisting 40 research alliances in their work to enhance the potential for use of valuable raw materials. The joint projects under the programme include REWITA, HTMET, DIBRAS, ELEXSA and r⁴-INTRA, in all of which CUTEC is involved. Scientists and companies are developing joint technologies for the environmentally sustainable mining or recycling of indium, gallium and other metals of importance to German industry. They presented their research work at a Status Conference in Hanover on October 20 and 21, 2016. The conference was hosted by the Federal Institute for Geosciences and Natural Resources BGR and the CUTEC Institute.

Local ore deposits containing rare metals form a research focus within the BMBF's sponsorship programme titled "r⁴ – Innovative technologies for resource efficiency – Research for the provision of industrially key strategic raw materials". To that end, researchers are developing state-of-the-art technologies by which even small deposits can be explored and mined. The second research focus is on the recycling and recirculation of industrially key strategic raw materials. In this area, raw materials researchers are investigating the spoil from former mines, or seeking new methods of recycling electronic waste.

Some 18 months after the launch of the BMBF's 60 million Euro "r⁴" funding scheme, scientists and business leaders presented details of their projects and the initial results

Group photo of the project coordinators

obtained. 26 research projects were begun in the first half of 2015. They included the "DESMEX" team, who are analysing deposits around Germany by helicopter using magnetic sensors; and the "REWITA" research team, investigating ways of extracting the resources such as indium, cobalt and gold in tailings of the former Rammelsberg ore mine.

A further 14 research alliances began their work within the "r⁴" programme in June 2016. Subjects they are working on include the search for new raw material sources in the sands of the Baltic sea ("SEEsand" project) and in the North German Basin oil and gas exploration field ("MinNoBeck" project). The "Dibras" research team is engaged in developing new technologies, among other activities. They are aimed at recovering valuable raw materials such as chromium, molybdenum, vanadium, niobium and tin from industrial slag and filter dust. More information at: www.r4-innovation.de and www.fona.de (bt)

Dr. Ulrich Schwartz-Schampera (BGR) (l.) shows Dr. Helmut Löwe (BMBF) and attendees at the Status Conference some marine mineral raw materials

The CUTEC Institute's r⁴-INTRA team: Dr. Torsten Zeller, alliance coordinator Prof. Martin Faulstich, Dr. Britta Kragert and Dipl.-Ing. Andre Bertram (from left)

FIFTY ISSUES OF CUTEC NEWS

This is the 50th issue of CUTEC News. Who would have thought, back in 2001 when we were planning the first issue, that it would achieve such lasting success?

Prof. Otto Carlowitz, the Institute's Managing Director at the time, initiated the newsletter as a channel for providing interested clients and partners with an insight into our research and development work.

Over the years, our hard-working editorial staff have produced more than 600 articles. We are glad to take this opportunity to thank them most warmly.

Many thanks go also to our former editors-in-chief, Götz Jonas (Dipl.-Phys.), Prof. Sven Klaus and Dr. Thomas Heere. Their commitment has been a constant example and inspiration to us all.

And last but certainly not least, we thank you, our loyal readers. This success would not have been possible without you.

We look forward to the 51st issue, and we very much hope that you will continue to support us in future. (wes)

DIRECT USE OF SELF-REDUCING BRIQUETTES IN STEELWORKS AND FOUNDRIES TO IMPROVE RESOURCE EFFICIENCY (DIBRAS)

On August 1, 2016 the BMBF-sponsored joint research project "DIBRAS", a German acronym relating to the direct use of self-reducing briquettes in steelworks and foundries to improve resource efficiency, was launched. The project is being coordinated by the Institute of Metals Technologies in the Department of Iron and Steel Production Metallurgy at the University of Duisburg-Essen, represented by Prof. Dr.-Ing. Rüdiger Deike. In addition to the second research partner, the CUTEC Department of Resource Technology, the project is being run in cooperation with the following partners:

- RHM Rohstoffhandelsgesellschaft mbH (RHM), Mülheim on Ruhr
- Dörrenberg Edelstahl GmbH, Engelskirchen-Ründeroth
- Friedr. Lohmann GmbH Werk für Spezial- & Edelstähle, Witten

as well as associated national and international actors, particularly from the partner country Brazil. The cross-sectoral and international structure of this project ensures that the research results are aligned to the economic requirements, and if successful will be almost ready for industrial implementation. The project is scheduled to run for three years, and is being funded with a grant of 1.944 million Euro from the sponsorship scheme titled "r⁴ – Innovative technologies for resource efficiency – Research for the provision of industrially key strategic raw materials" as part of the BMBF's "FONA" (Research for sustainable development) programme.

The production of high-alloy steels typically involves alloying with the elements chromium, cobalt, molybdenum, nickel, niobium, vanadium and tungsten, depending on the targeted steel quality. These steel alloys are classed as industrially key strategic raw materials, and as such are among the metals which must be reliably available for the development of future technologies, as they have a major leverage effect for the economy.

Photo: Andreas Kahrl, University of Duisburg-Essen

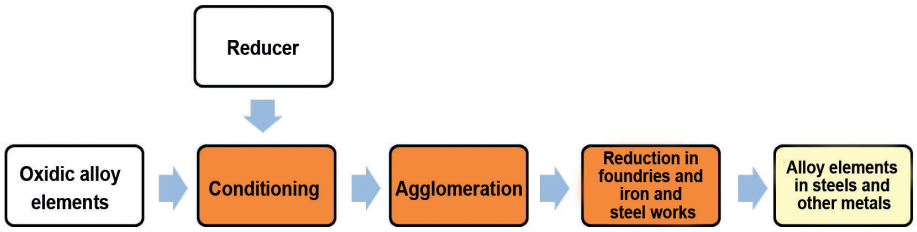
Recycling at high temperatures: DIBRAS recovers valuable metals from residual materials

In the manufacture of high-alloy steel products, certain portions of these high-grade alloying elements are currently converted into waste materials such as slag, mill scale, filter dust and oversprays. They are mostly distributed in such waste materials in the form of oxides, and so have to date been lost to the recycling process. For example, it has so far been rarely possible to re-use slag from stainless steel production and filter dust, even though they still contain many valuable elements. By-products of metallurgical processes are regularly used in the cement industry and in roadbuilding.

The primary aim of the project is to develop an innovative technology for the future recovery of these high-grade alloying elements from the waste products of steel alloy production and processing. The recycling process developed within the project alliance (see picture bottom left) is based not on recovering metals as secondary raw materials in high-purity form, but rather on using them directly in-house as alloying briquettes in the production processes from which they originated as waste products. An initial estimate has revealed that this is a lower-cost solution, so offering the opportunity to recover valuable metals even from complex material mixes in an economical way.

Recovery of industrially key strategic metals from slag by Brazilian project partner Resind

This innovative technique is intended to replace conventional complex process steps for the production of metal alloy elements by direct reduction in the smelting process at the production plant or in a separate smelting furnace. Another advantage of this technique is that some of the residual materials are classified as hazardous according to German Waste Listing Regulation (AVV), and licences to treat them are not issued by the competent authorities in some places. In-process recycling based on the method suggested here would offer significant benefits. "Expected secondary objectives include significant savings on resource consumption, combined with energy and CO_2 savings based on intelligent recycling," anticipates Resource Technology team representative Dr. Torsten Zeller. (sr)



Process schematic of the re-use of oxidic alloy elements

EFFECT OF AMENDMENTS TO THE 17TH FEDERAL IMMISSION CONTROL REGULATION

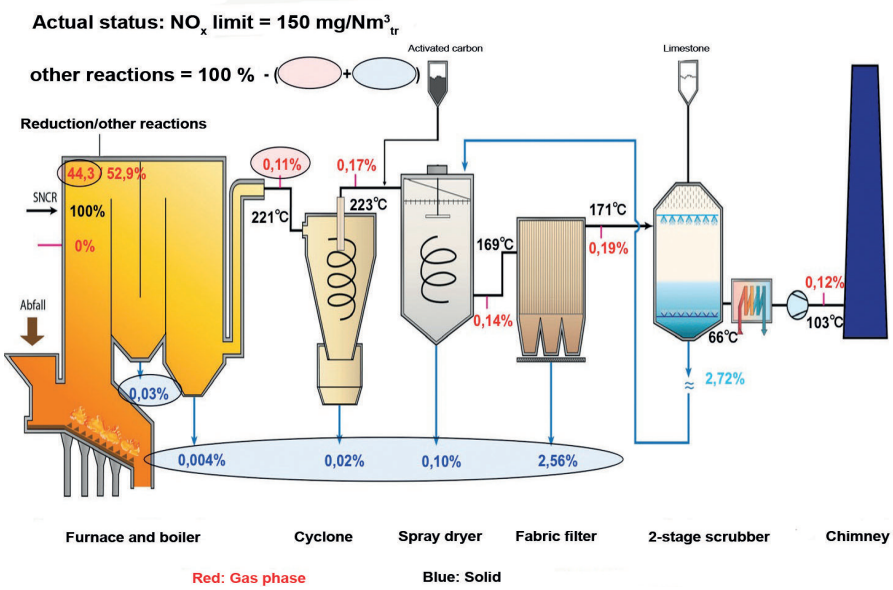
or

Do amendments to environmental laws always result in better environmental protection?

An amendment to the 17th Federal Immission Control Regulation (BImSchV) came into force on May 2, 2013. The Regulation stipulates requirements for the construction, design features and operation of waste incineration plants. New provisions include a reduction of the emission limits for nitrogen oxides and the introduction of limits for ammonia slip from the chimneys of existing and new plants. The Regulation poses a particular challenge for plants employing the widespread SNCR (Selective Non-Catalytic Reduction) technology.

In its research project on "the material location of ammonia in SNCR processes in flue gas and residual material channels at German waste incineration plants", the Essen-based VGB research foundation investigated the effects of a possible further reduction of NO_x limits. Measurements at six existing waste incineration plants and RDF power plants, with subsequent scientific evaluation of the results, additionally sought to predict the consequences of further reductions in limit values. The project was overseen by a committee comprising representatives of plant operators and manufacturers and vendors of SNCR plants (see picture below). In addition to providing substantial co-financing, the committee contributed the plant resources and know-how, as well as providing constructive guidance for the further procedure at half-yearly meetings. This ensured that research activities remained closely oriented to application needs. The project ran from July 1, 2014 to December 31, 2016.

Company logos of the members of the project oversight committee



Example assessment of ammonia location

The aim was for the experiments to test three states as far as possible: 1. Operation at the plant-specific NO_x limits; 2. Operation at reduced limits; 3. Short-time operation without SNCR. As expected, the plants with gas scrubbers in their flue systems were very well able to withstand a reduction in limits. The ammonia slip rose on a plant-specific basis from approximately 0.8 to approximately 1.5 mg/Nm³. The permissible daily average limit value is 10 mg/Nm³. However, the plants featuring dry or quasi-dry flue gas cleaning technology recorded significant increases in ammonia slip to a range from 7 to 9 mg/Nm³ when the nominal NO_x value was reduced from 100 to 120 mg/Nm³ in some regions. The reason is that lowering limit values results in a significant increase in reducer, i.e. ammonia water or urea solution, as the SNCR agent. The efficiency of the reducer was significantly impaired in terms of the desired reduction reactions; the number of secondary reactions increased.

Increasing the reducer input can, however, lower NO_x emissions. Other consequences of the increased reducer input, alongside increased slip, included much higher ammonium content in the boiler ash and filter dust of the flue gas cleaning system. Thus, the residual material disposal channels previously used would not yet be at risk of elimination, but would need to be reviewed on a case-by-case basis. It should further be noted that the reducer has to be produced and transported. CO_2 emissions are produced in the process. With a 50 mg/Nm³ reduction of the NO_x limit, the emissions for ammonia production and an estimated transport distance of 100 km are an additional 1 to 2 kg of CO_2 per tonne of waste. While this is low compared to the average CO_2 equivalent of 383 kg per tonne of waste, it is worthy of note, particularly in view of the fact that this would entail a reduction of the percentage of Germany's total NO_x emissions attributable to the NO_x content of waste incineration at waste incineration plants and RDF power plants only from approximately 1.0 to 0.6 %.

All in all, in addition to the detailed findings evaluations were possible on various plants featuring different flue gas cleaning system configurations. A good data base was established in order to provide answers to future questions relating to reductions in NO_x and NH^3 limits. The existing knowledge in relation to single plants has been placed on a broader basis. The early results were well received at the VGB conference on "Thermal waste reclamation and fluidised bed incineration" on November 15, 2016 in Berlin. The plan for the coming months is to disseminate them in various journals to a broader scientific readership as well as in industry media targeted at decision-makers. (vo)

REFIT FOR RESOURCE EFFICIENCY

The Material Flows working group of the Department of Resource Technology has taken on the task of supporting and advancing the saving, recovering and recycling of input materials based on analysis of usage and recycling channels. The incorporation of the overall system of material usage into these analyses has frequently proven advantageous, as only an unrestricted perspective enables new ideas to be adopted and new ways of interconnecting material flows to be found. The interdisciplinary nature of the working group is a key factor.

Industry 4.0 technologies are becoming increasingly widespread in production operations. They are providing previously unattained levels of knowledge on operating states and processes, which creates a basis for simulation of the effects of planned changes. The challenge in this is to understand and optimise cost-effectiveness, energy efficiency and material efficiency as a unified whole – an approach about which companies are still rather uncertain based on observations to date. The focus is initially placed on the "low-hanging-fruits" of in-house resource optimisation, which will deliver substantial savings at minimal effort and expense, so enabling cost-effective and environmentally friendly operations. Moreover, wide-scaled knowledge of material and energy flows permits interlinking of neighbouring systems to promote circular economy.

For this purpose, a software solution is being developed bearing the brand name ReFIT (Resource Flow Improvement Tool). It is intended for industrial application and can be customised for companies or for external consultants according to the task at hand. Diverse industry contacts underlined the need for such a product. The plan is to create functionality at various levels: in-house, cross-company, and even interlinking different companies at a certain location. The development of the first module – a software solution for resource efficiency consultants – is already in progress.

developed by CUTEC ReFIT

The brand name ReFIT not only refers to the software but also for consulting and agency services provided by CUTEC for companies or regional bodies in the field of resource efficiency. In this context, the Department of Resource Technology is also engaged in establishing the Lower Saxony Resource Efficiency Forum (FoReN). This will play a key role in the rapid dissemination and implementation of future advances in resource efficiency approaches.. (ke/see)

FEASIBILITY STUDY FOR THE CREATION OF AN ECOLOGICALLY SUSTAINABLE TOURISM INDUSTRY ON THE MEDITERRANEAN COAST OF ALBANIA

On October 1, 2016 an application by the Department of Energy System Analysis was approved by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) as part of its "Environmental Technologies Export Initiative" sponsorship programme. On the initiative of the German RETech Partnership (of which Armida Hemeling from the Tübingen-based Goduni International Advisory Board heads the South East Europe working group and Martin Faulstich is Chairman of the Advisory Board) a project proposal was produced for Albania.

The project concerns the drafting of a feasibility study for an ecologically sustainable tourism industry in Albania. A project location will be selected where the necessary measures for an ecologically sustainable tourism industry will be modelled. The results of the study can then be applied as a blueprint for other locations. Dr. Werner Siemers from CUTEC and Armida Hemeling from Goduni were in Albania from November 17 to 19 in order to announce the project kick-off and to make an inspection tour of the selected region. In consultation with the Ministry and the local administration, the town of Himare has been chosen to be a model for the development of an "eco village". CUTEC will primarily be concerned with the necessary infrastructure for waste disposal and sewage treatment. The example of the planned "Eco Village Tourism Himare" project is intended to demonstrate the technical and organisational possibilities for creating a sustainable utility infrastructure. This includes, for example, waste collection and recycling stations, organic waste separation, disposal of residual waste, and sorting of recyclable materials.

The Himare project area in Albania

In terms of sewage facilities, the project aims include avoiding sewage production, utilising grey water, and the adapted operation of treatment plants. In both areas, the systems are not yet established to an extent that would be necessary for a sustainable analysis. Consequently, if the tourism sector were to be expanded without implementing appropriate measures there would be a risk of severe environmental pollution by tourists on this part of the Mediterranean coast. (sie)

CUTEC INSTITUTE JOINS ZUSE COMMUNITY

The representative body for industry-related research establishments in Germany – the Zuse community – is expanding.

The CUTEC Institute has been accepted as a new member.

Founded in 2015, the German industrial research community Deutsche Industrieforschungsgemeinschaft Konrad Zuse e. V. represents the public interests of non-profit industrial research establishments in Germany. The members of the multi-technology, multi-sector community include independent research establishments from all over Germany, offering a wide range of technology expertise.

Dr.-Ing. Ralf-Uwe Bauer, President of the Zuse community, is delighted to welcome the new member: "The Zuse community has set stringent evaluation criteria for membership, in order to ensure that industrial research and development is represented by strong institutions. With the inclusion of the renowned CUTEC Institute, the Zuse community is now in a position to significantly enhance its strength in the energy and raw materials research sector."

Professor Martin Faulstich, Managing Director of the CUTEC Institute, is very pleased that the organisation has passed the admission procedure and will in future be strengthening the Zuse community: "Industrial research institutes targeted at the SME sector are widespread geographically, and located close to their clients. Such a bundling of expertise in the Zuse community was long overdue. We are delighted that our team now has the opportunity to contribute to the community." (meb)

Dr. Ralf-Uwe Bauer (centre) presents the certificate of admission to CUTEC head Prof. Martin Faulstich (on the right in the picture) and commercial director Martin Eberhardt

CAMEROONIAN CULTURAL WEEK LAUNCHED AT THE CUTEC INSTITUTE

The CUTEC subject areas of raw materials and energy are mega-issues for Africa. It was in that context that Prof. Dr.-Ing. Martin Faulstich officially opened the 15th Cameroonian Culture Week run by the Clausthal Students from Cameroon Club (CSK). "We are keen to expand the cooperation," stated the CUTEC managing director, addressing CSK chairman Cedric Tchamadeu Toko and the attending guests. CSK chairman Tchamadeu agreed.

Looking back to the founding of the CSK in 2001, Christien Petcha praised Cameroon as a diverse country whose population is full of ideas and dynamism. He went on to state that those attributes are also demonstrated by the academic, sporting and cultural events organised by the club, which bring people from all over the world closer together in the Upper Harz region. "You are a very vital people", affirmed Pastor Dr. Heiner Wajemann from the Protestant Students Community. Councillor Martin Ksink, representing Mayor Britta Schweigel, passed on her best wishes and acclaimed the extent to which the students from Cameroon contribute to the life of the university town, including at municipal celebrations, at the Technical University of Clausthal's Courtyard Festival, and at the Christmas Get-Together in the university dining hall. The tastes, sounds and colours of the African nation, which describes itself as "Africa in miniature", are perceptible all around.

Prof. Faulstich (centre) together with students from Cameroon, town councillors, and student pastor Dr. Wajemann

The art exhibition hosted at the CUTEC Institute as part of the Cultural Week also provided a fascinating insight into Cameroonian culture. The renowned artist Michelle Nze from Berlin exhibited sculptures and pictures. In a lecture presented in her role as an ambassador of sub-Saharan African culture she explained the significance of initiation rites. TU student Fabien Diffé showed his highly expressive paintings, which were much praised. The artist also gave a musical performance. Muriel Mben talked about Cameroonian literature, while Aiida presented colourful clothing. (bt)

CUTEC ON THE ROAD

VISIONS FOR THE FUTURE OF THERMAL WASTE TREATMENT

On September 21 and 22, the Association of German Engineers (VDI) and ITAD (the interest group representing thermal waste treatment plants in Germany) hosted the 28th Thermal Waste Treatment Conference in Würzburg. The day before, interested parties gathered for a special event day on the subject of "Visions for the future of thermal waste treatment". At the event, Dr. Vodegel from the CUTEC Institute presented a paper on the subject of "Social and legal influences on waste flows". The presentation was based primarily on a recently completed study by the German Environmental Agency UBA in conjunction with the Fraunhofer UMSICHT in Sulzbach-Rosenberg. The key theme is that life-cycle management involving increased material recycling does not automatically result in a reduction in thermal recovery. Quite the contrary in fact: From the introduction of the German Life-cycle Management Act in 1996 through to around 2010 both material recycling rates and thermal capacities rose sharply. The 25 million tonne p.a. capacity of RDF power plants and waste incineration plants is being fully utilised. The causes are

Picture caption: Live from the hall

wide-ranging: The population is rising, in spite of forecasts to the contrary; urbanisation is increasing; and legislation (such as Germany's energy transition laws) at national and European level is bringing new waste flows to the market. The presentation attracted great interest, and was also featured as a full-page article in the EUWID "Recycling and disposal", no. 39.2016. (vo

NINTH LOWER SAXONY ENERGY CONFERENCE (NET) 2016

The ninth Lower Saxony Energy Conference (NET) was held in Goslar on the November 1st and 2nd. The event was organised by the Lower Saxony Energy Research Centre EFZN, and the contents and programme were made by an interdisciplinary commission. This year's keynote topics were the effects of fluctuating infeed of renewable energy on German industrial areas and society. Over 200 experts gathered to debate the related issues on the first day of the event in the Imperial Palace (Kaiserpfalz) in Goslar. The patron of this year's event was the Lower Saxony Economy Minister Olaf Lies.

During the forum programme on the second day of the event, specific issues relating to the energy transition were considered in greater detail. The Forum 4 titled "Energy transition: A new [renewable] world of work" was opened with a presentation by Dr. Jens zum Hingst from the Department of Energy System Analysis. He presented the results of the Lower Saxony Energy Scenarios. These scenarios for a complete energy supply of the Lower Saxony on the basis of renewable energies were developed under the leadership of the CUTEC Institute in cooperation with the Lower Saxony Energy Research Centre (EFZN), the Hameln Institute for Solar Energy Research (ISFH) and the LiFE 2050 energy research cluster at the Leibniz University in Hanover on behalf of the Lower Saxony Ministry of the Environment, Energy and Climate Protection. (zh)

Dr. zum Hingst (left) presents the results of the Lower Saxony Energy Scenarios

MEMBERS' ASSEMBLY OF THE SUBSTITUTE FUELS, WASTE WOOD AND BIOGENIC WASTES ASSOCIATION

Dr. Vodegel during his presentation

The German Federal Association of Secondary Raw Materials and Waste Management (bvse) held this year's annual assembly from September 21 to 23 in Bremen. Members' assemblies reviewed the activities and developments of the past year. A major issue was the impact of statutory changes on everyday business operations, allied to the question of how the bvse will be able to contribute to planned amendments from an early stage. One of the key regulations is the Trade Waste Ordinance. In order to make clear to legislators that there are differences in recycling for energy use, in late 2015 the CUTEC Institute was commissioned to draw up a study titled "Differentiation of recycling for energy use based on the criterion of energy efficiency". Dr. Vodegel presented the results. At the request of the members' assembly, the results will be utilised by the bvse over the coming months in technical cooperation with CUTEC. The background to this is the expected increase in processed quantities of high calorific value waste in the coming years.

Based on the high-quality processing methods commonly applied by bvse member-companies, high-grade recycling with very good efficiency levels can be achieved for both energy and material use. Sham recycling involving low levels of energy efficiency should be restricted by policy measures. (vo)

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